## Subject Index

Acmite 253 actinolite 185, 354 activities, lava components 146f. composition relations, Fe<sup>2+</sup>/Fe<sup>3+</sup> 369ff. adularia, felsic spilites 15f. -, replacing plagioclase 16 aegirine, Zr-bearing 251f. Al, aluminosilicate melts 257f. albite 15, 80, 408 albitization 16 alkali basalts 175 -, Sm-Nd data 48 alkali chloride solutions, supercritical alkali feldspar 78, 261, 270 alkali pyroxenes 251 alloys, exsolution phases 309 alnoite 44 -, Sm-Nd data 47 Al<sub>2</sub>O<sub>3</sub>, pyroxene-garnet equilibrium 295f. -, effect on diopside-enstatite miscibility gap 298 alpine peridotite 48 amphibole 362, 388, 408 -, sodic 181 amphibolite 98, 154, 328, 388 granulite facies transition, water activity 377ff. analcite 5, 270, 408 andalusite 245, 349 andesine 134 andesite 56 anhydrite 5 anorogenic volcanism, Queensland 129ff. anorthite 123, 408 anorthoclase 140 antigorite 106 apatite 167, 270 aragonite 408 augite 58, 131, 135, 360 -, Al- ~ 141 - syenite 251

## Basalt 55

-, correlation of P with light REE 165ff.
- genesis, models 395ff.
-, O and Sr isotopic correlation 199ff.
-, Queensland 129ff.
- /seawater interactions 1 ff.
- -, fluid chemistry 3 f.
- -, secondary minerals 5
- -, temperature gradient experiments 5 f. basaltic magma chamber 280 f.
-, crystallization and crystal settling 282
-, fractionation trends 225 ff.
-, temperature history 281

-,Zn saturation 335 blueschist belt 179f. boninites 353f. bronzite, Al- 141 brucite 103

biotite 123, 343, 379

-, breakdown 327f.

Calcite 8, 98, 102, 123, 354, 408 camptonite 270

carbonatites 44

-, Sm-Nd data 47
carbonatization, metamorphic assemblages 79f.

Ce-Yb, Tichka massif 94
chalcopyrite 332
chemical analysis

-, aegirines, Zr-bearing 252

-, amphiboles, eclogite 389

-, -, Olivine pyroxenite 362

-, -, sodic 182

-, augite, olivine pyroxenite 360

-, basalts, Antarctica 202

-, biotite, pelitic gneiss 380

-, -, Western Tauern marls 124

-, chondrodite, marble 100
-, chromite, New Zealand 159
-, -, oliv. pyroxenite 357
-, clinoenstatite, oliv. pyroxenite 359
-, clinohumite, marble 100
-, clinopyroxene, eclogite 388
-, -, kimberlite xenoliths 29
-, -, Papua ultramafics 59
-, -, pelitic gneiss 383

-, calcite, West. Tauern marls 124

-, -, Western Tauern marls 124

-, chlorite, blueschists 182

-, -, marble 102

-, diabase dikes, Michigan 410
-, diopside, marble 104
-, diorite, Tichka 90
-, dolomite, Western Tauern marls 124

-, epidotes, eclogite 390
-, gabbros, Tichka 91
-, garnets, Kimberlite xenoliths 31
-, -, pelitic gneiss 380
-, glass, Howqua 371
-, granites, Tichka massif 90
-, hornblende, pelitic gneiss 380
-, ilmenites, kimberlites 320
-, -, trap sill 75

-, kyanite, New Zealand 156

-, -, pyroxenes 140

-, lavas, mafic, Queensland 134

-, -, Cr-spinels 141 -, -, Fe-Ti oxides 142 -, -, lherzolite inclusion minerals 143 -, -, phlogopites 142

-, leucoxene, blueschists 182 -, magnetite, trap sill 75 -, margarite, New Zealand 157 -, metapelites, gahnite-bearing 329 -, -, biotite 331 -, -, chlorite 331

-, -, cordierite 331
-, -, garnet 333
-, -, muscovite 333
-, -, spinels 331
-, metavolcanics, Ascot 81
-, micas, eclogite 390
-, -, New Zealand 157

-, ocelli-matrix pairs, lamprophyres
-, olivine, kimberlite xenoliths
29
-, -, Tichka
-, -, trap sill
74

–, olivine pyroxenite 363–, –, olivines 356

-, orthopyroxene, kimberlite xenoliths 34 -, -, Papua ultramafics 59 -, -, pelitic gneiss 383 -, -, pyroxenite 361 -, -, tectonic peridotite 57 -, peridotites, Baldissero 113 -, -, clinopyroxene 116 -, -, olivine 115 -, -, orthopyroxene 115 -, -, spinels 116 -, phengite, blueschists 182 -, phlogopite, kimberlite xenoliths 36 -, pigeonite, oliv. pyroxenite 360 -, pyroxene, sodic, blueschists 182 -, -, trap sill 77 -, pyroxenites 228 -, -, clinopyroxenes 228 -, scapolite, New Zealand 158 -, siderophile particles, impact structure 190 -, spinel, harzburgites 57

-, tremolite, marble 104
-, -, Western Tauern marls 124
-, ultramafic belt rocks, Papua 61
-, zoisite, New Zealand 158
-, -, Western Tauern marls 124
chemical variation, magma chamber 279
cherts 179
chlorite 80, 98, 102, 123, 157, 180, 270, 3271., 408
-, expandable 5
chromite 155, 358
chondrodite 100, 205

, expandable 5
chromite 155, 358
chondrodite 100, 205
clay minerals, interlayering 309 f.
clinoenstatite 353 ff.
clinohumite 98, 205
–, complex twinning 100
clinopyroxene 28, 112, 170, 291, 383, 388, 408
— meacrysts, kimberlites

 megacrysts, kimberlites, Sm-Nd data 50
Co, granulites 229
compressibility, porphyroblasts 340
cooling, effect on seawater/basalt
interactions 2

cordierite 327, 332, 379
Cr, clinopyroxenite 228
creep mechanism 340
Cr-rich kyanites 154 f.
Cr-spinel 57, 135
crustal contamination 199
crystallization, magma chamber 282
- sequence, boninites 365
- , kimberlites 318

- rates, melt layers 284f.

crystal settling, magma chamber 282 Cu, granulites 229 cumulate peridotite 58

-, ultrabasic rocks 286
cyclic layering, ultrabasic rocks 285f.

cyclic layering, ultrabasic rocks 2651.

Dacite 56 dehydration equilibria 377 diabase dikes 395ff. differentiation, Queensland lavas 136 –, trap sill magma 76 dikes 270

 Ivrea peridotites 112f. diopside 98, 104, 253

- enstatite miscibility gap, effect of Al<sub>2</sub>O<sub>3</sub> 298

 orthopyroxene solid solution 301 f. diorite 89

- origin 93

disequilibrium melting 170 dislocations, micas 312 disordering, diopside 305 dolerite 179 dolomite 98, 102, 123, 214 dunite 28, 286

Eclogites, kimberlites 45 -, P-T conditions 399 ff. element mobility, metabasalts 81 f. epidote 390, 408 eudialite 253

nepheline syenite 251

F, aluminosilicate melts 257f. favalite 375 felsic segregations, lamprophyres 270 felsic spilites 15f.

-, O isotopic composition 18

-, trace elements 17 Fe-Mg substitution, effect on phase relations, marly rocks 123ff. ferric-ferrous liquids, silicate melts 369ff. Fe-Ti oxides, Queensland lavas 138 forsterite 98, 102 fourchite sill 270 fractional crystallization, basalts, Precambrian 413

-, gabbros 93 -, granites 90

fractionation, clinopyroxenes 231 - trends, basaltic magmas 225ff.

fuchsite 157

Gabbro 55, 89, 179 gahnite 327ff. galena 192

garnet 28, 170, 333, 341, 387f.

- peridotite inclusions, kimberlites 45

- pyroxene equilibrium 294f. geikielite 321

geobarometry 292 -, Ivrea peridotites 115

geochronology, Lu-Hf isotopes 266f.

geothermometry 292, 362, 390

-, kimberlite xenoliths 32

-, peridotites, Ivrea 115

glass 375

glaucophane 181, 408

- schist 407 gneiss 327, 387f. grain translation 340

granites 89, 328

-, formation 21

-, -, fractional crystallization model 90

-, -, partial melting model 91 granulites 225, 388

-, kimberlites 45 graphite 123, 340f.

greenstones 354f.

-, trace elements 18 Greig diagram 274 greywackes 179

, partial melting 23f. Guinier-Preston zones, alloys 309

Harrisite 287 harzburgite 28, 57 hastingsite 270 hawaiites 133f.

heat flux, basaltic magma 280 f.

hedenbergite 253 hematite 5, 321, 408 hercynite 327

stability 333

Hf, chemical separation 264

-, Zr-aegirines 251f. high-level magma chamber 280 Hisotopes, granites 392f.

hornblende 157, 382, 390 - granulite 58

hot springs, submarine 1 f. humite minerals, phase equilibria 205ff.

Ilmenite 28, 75, 131, 140

-, kimberlitic 315ff.

-, -, megacrysts, formation 321

-, -, types 315

immiscibility fields, silicate/liquid 274

immiscible liquids 269f. impact structure 187f.

interface, magma chamber 282 interlayering, kaolinite 310f.

-, mica 310

interstitial pyroxenes, oliv. pyroxenite 360 interstratification, phyllosilicates 309f. thermodynamic implications 313f. ion-exchange, Lu-Hf separation 264 island arc volcanoes 279

Jadeite 253, 408

Kaersutite 48

kaolinite, interlayers 310 karlite 103

K-feldspar 123, 378 kimberlite 299

- diatremes, xenoliths 27 ff.

-, megacrysts 315ff.

-, -, crystallization sequence 318

-, origin 50f.

 Sm–Nd systematics 43f. kimberlitic ilmenites 315ff.

kyanite 387

amphibolite 155

- schists, New Zealand 153ff.

Labradorite 134, 155

lamprophyres 270ff. larvikite 251

La/Sm, Precambrian basalts 400

laumontite 408 lavas 179

-, Fe2+/Fe3+ activities 374

-, Precambrian 395ff.

-, Queensland 129ff.

lawsonite 179f. 408

layered ultrabasic rocks 286

-, quench textures 287

layers, magma chambers 284

leucite 375 leucoxene 181

Iherzolite 229 - nodules 299

-, Sm-Nd data 49

limestone 205

liquid-solid equilibria 369

liquidus phase relationships, Qz-Ab-Or system 259

ludwigite 98

Lu-Hf isotope geochemistry 263f. -, determination of elements 265

lujavrite 251

Magma chamber, fluid dynamics 279ff.

magnesite 107

magnetite 28, 75, 315, 375 mantle, dynamic processes 353

- evolution 51f.

- heterogeneity 174f.

- peridotites 111f.

-, source of basic magmas,

P-rich phase 166f.

marble lenses, mineral assemblages 99

-, phase relations 97ff.

margarite 123, 155

marls, Fe-Mg substitution 123ff.

mechanical processes, porphyroblast growth 340

megacrysts, kimberlite xenoliths 35f.

-, fractionation trends 39 melt, basaltic 283f.

compositions, Baldissero

peridotite, calculated 119

density variation 283 - rocks, impact structure 187f.

-, structures 257 f.

metabasites 180

metacherts 154

metagreywackes, composition 23

metamorphic reactions,

thermodynamic data 409

rocks, mineral paragenesis 412

-, -, textural interpretation 339f.

zones 410f.

metamorphism, eclogites 391

-, high grade, New Zealand 159f.

-, role of water 377 ff.

-, Tauern 97ff.

metapelite, compositions 24

-, gahnite-bearing 327f.

metasomatism 82

metavolcanics, carbonatization 78ff.

meteorites 193, 353

Mg removal, seawater 2

mica 390 - arcs 342f.

domes 340f.

feldspar equilibria 235ff.

-, interlayering 311 f.

microstructures porphyroblast growth 340

mid-ocean iedges 279

migmatisation 98

millerite 189

mixed-layer clay 8
Miyashiro diagram 181
mobility of elements, metamorphism 81f.
molybdenite 332
monazite 332
monchiquite 270
muscovite 123, 157, 236, 311, 333, 340f.
– + quartz stability 378

Nd-Sm systematics, kimberlites 43 ff.
nepheline 270
- syenite 251
Ni, granulites 229
-, impactites 191 f.
norbergite 205
norite-gabbro 61

O, isotopic composition, Antarctic basalts 201 obsidian 375 ocelli 270f. - matrix data, element partitioning 270 ff. O fugacities, melts 374 OH-F exchange, humites 213f. O isotopes, granites 389f. olivine 28, 57, 113, 131, 135, 141, 225, 318, 355f. - pyroxenite 353f. - tholeiite 72 -, trap sill 72f. omphacite 399 ophicarbonate rocks 97f. ophiolites 55ff. ophiolitic lavas 365 ore formation, basalt/seawater interactions 10f. orthoclase 245 orthohumite 205 orthopyroxene 28, 57, 112, 291, 361, 383

orthopyroxenite 57 Parageneses, metamorphic rocks 412 paragonite 123, 242 pargasite 356f. partial interlayers, phyllosilicates 309f. partial melting 230 equations, nomenclature 168 equilibria 377 -, gabbros 93 -, granites 91 f. -, greywackes, mass balance 21 ff. -, ilmenite formation 321 -, pelitic rocks 24f. -, spinel-lherzolite 111ff. -, -, melting relations 117f. partition coefficients, REE, spinel and apatite 167 partitioning of elements, ocelli and mafic melt 270 ff. -, effect of polymerization 271 f. -, effect of solid phases 276 effect of temperature 277 pegmatites 98 pelitic gneiss, water activity 379

pentlandite 189

peridotite 28, 57f., 111f., 286

perovskite 315 phase equilibria, humite minerals 205ff. phase relations, marble lenses 104f. phenaite 181 phenocrysts, Queensland lavas 134f. phlogopite 103, 140 phyllosilicates 309f. picrite 283 pigeonite 78, 303, 360 plagioclase 5, 58, 72f., 123, 134, 155, 270, 328, 388f. pleonast 225 P-light rare earth elem. correlation in basalts 165f., 174f. polymerization ratio, ocelli-matrix pairs 272f. -, silicate melts 258 porphyroblast growth, mechanical processes 340 -, relations to matrix 339 f. prehnite 408 - pumpellyite zone 407f. protoenstatite 356 pumpellyite 408 pyrite 8, 193 pyroclastics 179 pyrophyllite, interlayering 313 pyroxene 253, 291 f. -, crystallization, olivine pyroxenite 361 -, sodic 180 -, trap sill 76f. pyroxenites 2 pyrrhotite 8, 193

Quartz 78, 123, 155, 183, 236, 242, 328, 343, 354, 388, 408 quartzite 328 quench textures, layered rocks 287

Rare earth elements, partition coefficients apatite/liquid 167 -, partitioning, ocelli/lamprophyre matrix 275 -, Precambrian basalts 411 -, pyroxenites 229 -, Tichka massif 90 -, ultramafics, Papua 64 regular solution model, diopsideorthopyroxene solid solution 301 f. replenishment mechanism, magma chamber 279ff. -, model 286 restite, greywacke partial melting 23 retrograde changes, kyanite schists 161 f. retrogressive metamorphism 327 rhyolite alteration 15f. riebeckite 181

Sanidine 237, 375
Sc, granulites 227
scapolite 156
seafloor spreading 1
seawater/basalt interactions 1 ff., 15f.
-, convective circulation 1 f.
secondary minerals, basalt/seawater
interactions 5

rutile 28, 315, 388, 408

sericite 311 serpentine 97f., 112, 354 serpentinite 112, 179 shales 179 sphalerite 192 siderophile particles, impact structures silica, amorphous 6 silicate liquid, ferric-ferrous equilibria 369 ff. immiscibility 269f. silicate melts 257 sills 270, 355 -, Deccan trap 71f. -, -, crystallization sequence 78 -, -, zonation 71 f. sillimanite 327, 332 - /K-feldspar isograd 378 Sm, kimberlites 46 smectite 5, 16 - illite interlayering 309 sphene 270, 408 spilites 15, 179f. spinel 57, 114, 131, 158, 167, 225, 318, 327ff. - Iherzolite 28 -, -, partial melting 111 ff. Sr isotopes, basalts 201 stress patterns, metamorphic rocks 346 subduction 353 zones, metamorphism 407ff. submarine hydrothermal systems 2 submarine metamorphism 1 supercritical alkali chloride solutions 235ff. syenites 251 f. systems, CaO-MgO-Al<sub>2</sub>O<sub>3</sub>-SiO<sub>2</sub> 291 ff.

Talc 107, 112, 157 "Tauernkristallisation" 98 tectonites, ultramafic 57 thermodynamic parameters. diopside-orthopyroxene solid solution 301 f. thermodynamic properties, metamorphic minerals 408 tholeiitic andesite 133 magma, fractionation trends 225 ff. Ti, basaltic magmas 228 - mobility, metabasalts 82f. titanomagnetite 75, 315 tonalite 58, 97 topotaxy, importance in low-grade metamorphism 184 tourmaline 98 trace elements, fractionation trends in basaltic magmas 225 ff. –, ocelli-matrix pairs 272f. trap intrusion, Deccan 71 f. tremolite 5, 98, 102, 123, 408 troctolite 58 twinning, clinoenstatite 355

Ultramafic belt, Papua 55 ff.

- granulites 227

- rocks, cyclic layering 285 f.

- xenoliths, kimberlites 27 ff.

upper mantle 27f., 43f. -, models 150 uplift, New Zealand amphibolite facies rocks 153

V, basalt magmas 228 volcanic environments 279 volcanism, Queensland 129 ff. Wairakite 408 water activity, metamorphism 337 ff. websterite 112

Xenocrysts, Queensland lavas 140

Y mobility, metabasalts 84

Zeolite zone 407f. zircon 263 zoisite 98, 123, 155, 408 Zr, aegirine 251f. -, mobility, metabasalts 83 - solubility in felsic melts 254

## **List of Locations**

Albert, Queensland 130 Allendale, Willyama Complex 378 Ascot Formation, Quebec 79

Baldissero, Ivrea Zone 112
Balmuccia, Ivrea Zone 112
Beardmore Glacier, Antarctica 200
Beechmont-Hobwee, Queensland 130
Bjensböle, Kemiö Region 328
Broken Hill, Australia 377
Bunya Mts., Queensland 130

Callander Bay, Ontario 270
Canavese Line, Ivrea Zone 112
Centennial, Willyama Complex 378
Chiusella River, Ivrea Zone 112
Clearwater Lake, Quebec 187

Delakhari, Deccan, India 72

Elliott Co., Kentucky 27

Finero, Ivrea Zone 112 Frei, Kristiansund area 388 Furtschaglhaus, Austria 98

Gardar Province, Greenland 251 Großer Möseler, Austria 98

Haast, Otago, New Zealand 154

Hochfeiler, Austria 98 Howqua River, Victoria 354

Ivrea-Verbano Zone, Italy 112

Jacobs River, New Zealand 154

Kemiö Region, Finland 328 Ketenlik, Turkey 183 Kirkpatrick Basalt, Antarctica 200 Kristiansund area, Norway 388 Kvalvåg, Frei 388

Lake Superior, Michigan 396 Laurel, Willyama Complex 378

Magnhildberget, Norway 388
Main Range, Queensland 130
Malaita, Solomon Islds. 299
Maleny, Queensland 130
Marlborough Schists, New Zealand 154
Marquette, Michigan 396
Monte Regian Hills, Quebec 269
Motzfeldt, Greenland 251
Mt. Falla, Antarctica 200
Mt. Johnson, Monteregian Hills 269
Mt. Rougemont, Monteregian Hills 270
Mt. Wellington Greenstone Belt, Vict. 354

Otago Belt, New Zealand 154 Owen Stanley Range, Papua 56

Papuan Ultramafic Belt 56

Quebec, Canada 269 Queen Alexandra Range, Antarctica 200

Schlegeistal, Austria 98
Sentinel, Willyama Complex 378
Sesia-Lanzo Zone, Ivrea Zone 112
Sherbrooke, Quebec 79
Springsure, Queensland 130
Strona-Ceneri Zone 112

Tauern Window, Austria 98
Tavşanli, Turkey 179
Tichka Massif, Morocco 89
Tingvoll Penins., Norway 388
Torlesse Terrane, New Zealand 154
Transantarctic Mts. 200
Träskböle, Kemiö 328
Tweed Shield Volcano, Queensland 131
Tynglax, Kemiö 328

Umbermuberka, Willyama Complex 378

Victoria, Australia 354

Willyama Complex, Australia 378 Winona, Michigan 396